

REMARKS

I. Introduction

In response to the Office Action dated March 20, 2008, new claims 19-26 have been added, and claims 1-18 have been amended. Claims 1-26 are in the application. Re-examination and re-consideration of the application is requested.

II. New Claims

Applicants' attorney has added claims 19-26 as indicated above. These new claims correspond to new claims 19-26 added during the Chapter II examination in the parent PCT application. Moreover, no fees are due, because Applicants' attorney paid for 26 claims when this application was filed, believing that the new claims added during the Chapter II examination would be entered in this application, because they were included with the filing of the application. However, the Office Action indicates that only claims 1-18 are present in the application, making it is apparent that the new claims were not entered into the application at the time of filing. Consequently, new claims 19-26 are now being added to the application. However, since the number of claims previously paid for at the time of filing this application equal the number of claims now in the application, no fees are due for these new claims.

III. Claim Amendments

Applicants' attorney has made amendments to the claims as indicated above. These amendments were made solely for the purpose of clarifying the language of the claims, and were not required for patentability or to distinguish the claims over the prior art. Moreover, these amendments do not include new matter and are supported by Applicants' specification at least at page 4, line 17 et seq.; page 6, line 20 et seq.; page 12, line 15 et seq.; as well as other portions of Applicants' specification.

IV. Prior-Art Rejections

A. The Office Action Rejections

On pages 2-3, the Office Action rejects claims 1-12 and 15-18 under 35 U.S.C. §102(b) as being anticipated by or, in the alternative, under 35 U.S.C. §103(a) as being obvious over Chang, U.S. Patent No. 6,441,403 (Chang). On pages 3-4, the Office Action rejects claims 1-18

under 35 U.S.C. §103(a) as being obvious over Chang in view of Nisitani, U.S. Patent No. 6,229,834 or Itaya, U.S. Patent No. 5,780,873 (Itaya).

Applicants' attorney respectfully traverses these rejections.

B. Applicants' Independent Claims

Applicants' independent claim 1 is directed to a Group-III nitride based light emitting diode (LED), wherein light is extracted through a surface of the nitrogen face (N-face) of the Group-III nitride based LED and the surface of the N-face of the Group-III nitride based LED is structured so that the light is extracted out of the Group-III nitride based LED.

Applicants' independent claim 17 is directed to a method of creating a Group-III nitride based light emitting diode (LED), wherein light is extracted through a structured surface of a nitrogen face (N-face) of the LED, comprising: structuring the surface of the N-face after growth to extract light out of the Group-III nitride based LED.

Applicants' independent claim 18 is directed to a Group-III nitride based light emitting diode (LED) comprised of an n-type electrode, n-type layer, active region, p-type layer and p-type electrode, wherein a nitrogen face (N-face) surface of the n-type layer is structured after growth so that light is extracted through the structured N-face surface of the n-type layer.

C. The Chang Reference

Chang discloses a semiconductor device with a roughened surface that increases external quantum efficiency. Roughening of the semiconductor device surface is done by epitaxial growth techniques that may include hydride vapor phase epitaxy (HVPE) technique, organometallic vapor phase epitaxy (OMVPE) technique, or molecular beam epitaxy (MBE) technique.

D. The Nisitani Reference

Nisitani discloses a semiconductor light emitting device having a double heterostructure. The device is composed of an active layer and clad layers that sandwich the active layer. At least one of the clad layers has a multilayer structure having at least two element layers. The Al mole fraction of an element layer, which is proximal to the active layer, of the multilayer structure is smaller than that of the other element layer thereof distal from the active layer. This arrangement

improves the crystal quality of an interface between the active layer and the clad layer of multilayer structure and effectively confines carriers in the active layer.

E. The Itaya Reference

Itaya discloses a semiconductor light-emitting device comprising a semiconductor light-emitting device section of a hexagonal type; and an electrically conductive semiconductor substrate of a cubic type combined into the semiconductor light-emitting device, and having an orientation of its cleavage facet conformed to an orientation of the cleavage facet of one of semiconductor layers forming the semiconductor light-emitting device section. The substrate of the cubic type is cleaved so that the semiconductor light-emitting device section of the hexagonal type is induced to be cleaved, and that a mirror surface can be easily formed.

F. The Applicants' Invention is Patentable Over the References

The Applicants' invention, as recited in independent claims 1, 17 and 18, is patentable over the references, because the independent claims contains limitations not taught by the references. Specifically, the references do not teach or suggest the specific combination of limitations found in Applicants' claims.

The Office Action, however, asserts the following:

Claims 1-12 and 15-18 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Chang 6,441,403.

Chang discloses in figures 5A and 5B a GaN based light emitting diode wherein light is extracted through a nitrogen face of the LED and a surface of the N-type GaN layer 300 has a roughened cone-shaped face. Claims 1-8 are rejected because the final structure is anticipated regardless of the process used to make the device. A product by process claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck 177 USPQ 523; In re Fessman 180 USPQ 324; In re Avery 186 USPQ 161; In re Wertheim 191 USPQ 90; and In re Marosi et al 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above case law makes clear.

Claim 9 is rejected because c-plane wafers are ordinary in the art and would have been obvious to practice in Chang, there being no unexpected results over Chang.

Claims 10-12 are rejected because Chang shows electrodes and the same material, and the electrodes of Chang are also highly reflective because they are metals.

Claims 15 and 16 are rejected because the formation of the cones in Chang result in an angle of similar magnitude.

Claim 17 is rejected because the formation of the Chang device results in a GaN device with a surface roughened N-face.

Claim 18 is likewise rejected as the final product does not structurally distinguish over Chang. See the above recited product by process case law.

Claims 1-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Nisitani 6,229,834 or Itaya 5,780,873.

Itaya suggests a current block or current confining frame as layer 216 to improve the device function of a Chang type device. Likewise Nisitani shows current block layers as 51 to be routine structure in these type led devices to improve current handling.

Claims 13 and 14 are obvious structure.

Applicants' attorney respectfully disagrees this analysis.

Chang discloses roughening of the gallium face (Ga-face) of the device, not the structuring of the nitrogen face (N-face) as recited in Applicants' claims.

Group-III nitride materials present two different faces, or polarities, when grown along the c-plane direction, which are the Group-III-face (0001) and the N-face (000-1). Traditionally, Group-III nitride growth is performed on the Group-III-face (0001). For example, in a typical GaN-based device, grown in a c-plane direction on a sapphire substrate, growth is performed on the gallium face (Ga-face) in the (0001) direction.

This is what is shown in Chang. Specifically, FIGS. 5A and 5B of Chang show a GaN layer 300 with a roughened top surface that is Ga-face, wherein the bottom surface of the GaN layer 14 that interfaces with the substrate 12 is N-face, which is not roughened in any way.

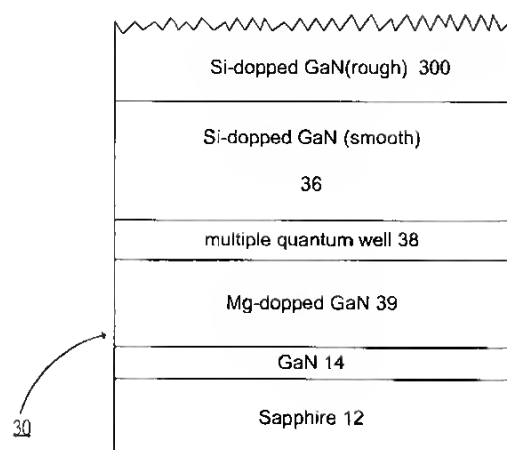


FIG. 5(A)

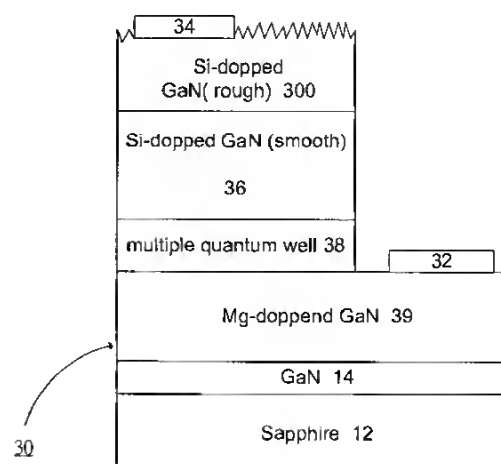


FIG. 5(B)

Moreover, note that, in Applicants' specification, the invention is described in the context of a laser lift-off (LLO) to remove the substrate and then using a flip-chip technology to have the N-face facing upward for subsequent structuring for light extraction.

Thus, Applicants' independent claims differ from Chang because these claims recite the structuring of the N-face, not the roughening of the Ga-face.

Note also that Chang creates a roughened Ga-face surface during the growth process, by directly growing a rough surface. This is to be contrasted with the method of Applicants' invention, as recited in independent claim 17, which structures the N-face surface after growth, e.g., by anisotropic etching. Chang's statements regarding the unsuitability of etching for GaN underscores the innovation of Applicants' invention.

Nisitani and Itaya fail to overcome the deficiencies of Chang. Consider that Nisitani and Itaya were cited only for teaching the current-blocking layer or current-confining frame found in Applicants' dependent claims 13 and 14. Moreover, Nisitani and Itaya refer to laser diodes, not light emitting diodes. In addition, neither Nisitani nor Itaya refer to N-face surface structuring to increase light extraction.

Finally, Applicants' claimed invention provides operational advantages over Chang, Nisitani and Itaya. These references reflect prior art approaches to light emitting devices, including the roughening of Ga-faces (Chang), and current confining layers (Nisitani and Itaya).

Applicants' invention, on the other hand, fabricates cone-like structures on an N-face surface of a Group-III nitride based LED using an anisotropic etching.

Thus, Applicants' attorney submits that the independent claims are allowable over Chang, Nisitani and Itaya. Further, the dependent claims are submitted to be allowable over Chang, Nisitani and Itaya in the same manner, because they are dependent on the independent claims, and because they contain all the limitations of the independent claims. In addition, the dependent claims recite additional novel elements not shown by Chang, Nisitani or Itaya.

V. Conclusion

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited.

Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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